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THE FUTURE OF SAFETY AND HEALTH AT WORK IN COLOMBIA. INNOVATION, DIGITALIZATION AND INTEGRAL WELL- BEING

**EL FUTURO DE LA SEGURIDAD Y SALUD EN EL TRABAJO
EN COLOMBIA INNOVACIÓN, DIGITALIZACIÓN Y
BIENESTAR INTEGRAL**

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The future of safety and health at work in Colombia. Innovation, digitalization and integral well-being

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ABSTRACT

Introduction: Occupational health and safety (OSH) in Colombia is going through a moment of profound transformation, driven by technological innovation, the digitalization of processes and an increasingly comprehensive vision of workplace well-being. In the last decade, the country has made significant progress in strengthening its regulatory framework and consolidating management systems that involve multiple actors, from the Ministries of Labor and Health to occupational risk administrators and joint committees in companies. However, fundamental challenges persist, such as the reduction of informality, the standardization of professional OSH training and the need to adapt regulation to the most demanding international standards. The digital revolution has begun to transform OSH management in Colombia, allowing the use of tools such as virtual platforms for training, real-time monitoring of risks and predictive analysis of incidents, which opens unprecedented opportunities for prevention and early intervention. Additionally, the COVID-19 pandemic accelerated the adoption of new practices, from teleworking to mental health care, underscoring the importance of a holistic approach that prioritizes the comprehensive well-being of workers. In this context, innovation not only translates into the adoption of new technologies, but also in the creation of organizational cultures that promote self-care, inclusion and equity, and in the implementation of policies that put people at the center of business management. The future of OSH in Colombia will depend on the ability of all actors to integrate these advances, overcome pending challenges and build safer, healthier and more inclusive work environments, in which digitalization and well-being are drivers of sustainable development and productivity. **Objective:** Analyze the evolution of occupational health and safety in Colombia, identifying how innovation and digitalization can be effectively integrated into management systems to strengthen the comprehensive well-being of workers, optimize the prevention of occupational risks and respond to the emerging challenges of the national productive environment, in compliance with current regulations and with a focus on sustainability and quality of work life. **Methodology:** The project will adopt a qualitative and descriptive approach, supported by documentary analysis, interviews with experts and case studies, to understand the evolution, challenges and opportunities of occupational health and safety (OSH) in Colombia under the prism of innovation, digitalization and comprehensive well-being. **Results:** The research reveals that Colombia has made significant progress in the consolidation of a robust regulatory framework and in the implementation of the Occupational Health and Safety Management System (SG-SST), which has allowed an improvement in the prevention and management of occupational risks. However, structural challenges persist, such as high labor informality, which exceeds 50% of the employed population and limits access to social protection and safe working conditions, increasing exposure to risks.

Keywords: digitalization, integral well-being, culture of prevention, work sustainability

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El futuro de la seguridad y salud en el trabajo en Colombia innovación, digitalización y bienestar integral

RESUMEN

Introducción: La seguridad y salud en el trabajo (SST) en Colombia atraviesa un momento de profunda transformación, impulsada por la innovación tecnológica, la digitalización de procesos y una visión cada vez más integral del bienestar laboral. En la última década, el país ha avanzado significativamente en el fortalecimiento de su marco normativo y en la consolidación de sistemas de gestión que involucran a múltiples actores, desde los ministerios de Trabajo y Salud hasta las administradoras de riesgos laborales y los comités paritarios en las empresas. Sin embargo, persisten retos fundamentales, como la reducción de la informalidad, la estandarización de la formación profesional en SST y la necesidad de adaptar la regulación a los estándares internacionales más exigentes. La revolución digital ha comenzado a transformar la gestión de la SST en Colombia, permitiendo el uso de herramientas como plataformas virtuales para capacitación, monitoreo en tiempo real de riesgos y análisis predictivo de incidentes, lo que abre oportunidades inéditas para la prevención y la intervención temprana. Además, la pandemia de COVID-19 aceleró la adopción de nuevas prácticas, desde el teletrabajo hasta la atención a la salud mental, subrayando la importancia de un enfoque holístico que priorice el bienestar integral de los trabajadores. En este contexto, la innovación no solo se traduce en la adopción de nuevas tecnologías, sino también en la creación de culturas organizacionales que promuevan el autocuidado, la inclusión y la equidad, y en la implementación de políticas que pongan a las personas en el centro de la gestión empresarial. El futuro de la SST en Colombia dependerá de la capacidad de todos los actores para integrar estos avances, superar los desafíos pendientes y construir entornos laborales más seguros, saludables e inclusivos, en los que la digitalización y el bienestar sean motores de desarrollo sostenible y productividad. **Objetivo:** Analizar la evolución de la seguridad y salud en el trabajo en Colombia, identificando cómo la innovación y la digitalización pueden integrarse de manera efectiva en los sistemas de gestión para fortalecer el bienestar integral de los trabajadores, optimizar la prevención de riesgos laborales y responder a los desafíos emergentes del entorno productivo nacional, en cumplimiento de la normatividad vigente y con enfoque en la sostenibilidad y la calidad de vida laboral. **Metodología:** El proyecto adoptará un enfoque cualitativo y descriptivo, apoyado en el análisis documental, entrevistas a expertos y estudio de casos, para comprender la evolución, retos y oportunidades de la seguridad y salud en el trabajo (SST) en Colombia bajo el prisma de la innovación, la digitalización y el bienestar integral. **Resultados:** La investigación revela que Colombia ha logrado avances significativos en la consolidación de un marco normativo robusto y en la implementación del Sistema de Gestión de Seguridad y Salud en el Trabajo (SG-SST), lo que ha permitido una mejora en la prevención y gestión de riesgos laborales, Sin embargo, persisten retos estructurales, como la alta informalidad laboral, que supera el 50% de la población ocupada y limita el acceso a la protección social y a condiciones laborales seguras, incrementando la exposición a riesgos

Palabras Claves: digitalización, bienestar integra, cultura de prevención, sostenibilidad laboral



INTRODUCTION

Occupational Health and Safety (OSH) in Colombia is in a key stage of evolution, marked by profound changes in the way of conceiving and managing the well-being of workers. The country has made important progress in consolidating policies and regulations that seek to protect the physical and mental integrity of employees, while globalization and the fourth industrial revolution demand more agile and adaptive responses. The integration of emerging technologies, the digitalization of processes and the growing awareness of the importance of healthy work environments have driven an unprecedented transformation in all productive sectors.

Despite this progress, Colombia faces persistent challenges, such as the need to reduce labor informality, strengthen OSH training, and harmonize its regulations with international standards. The recent experience of the COVID-19 pandemic has highlighted the urgency of adopting more flexible and innovative approaches, highlighting the relevance of mental health, teleworking and proactive risk prevention.

In this dynamic context, OSH is projected as a fundamental pillar for competitiveness and sustainable development, requiring the active participation of employers, workers, authorities and civil society. Only through collaboration and innovation will it be possible to build safer, healthier and more inclusive work environments, where technology and people's well-being are the central axis of growth and productivity in Colombia.

In the midst of a constantly changing work environment, Occupational Health and Safety (OSH) has acquired a strategic role in building more competitive and sustainable organizations in Colombia. The consolidation of safe and healthy work environments is no longer just a legal obligation, but an essential condition for the economic and social development of the country. This challenge requires the joint commitment of employers, workers, government entities and society in general, who must join forces to promote innovative and collaborative practices.

The integration of technology, together with a vision focused on the comprehensive well-being of people, is positioned as the driving force of transformation towards more inclusive, productive and resilient work spaces. Thus, OSH becomes a key element to boost productivity and growth, guaranteeing



that business progress goes hand in hand with the protection and care of those who form a fundamental part of the Colombian productive fabric.

The adoption of new technologies and the focus on the comprehensive well-being of workers are redefining the landscape of Occupational Safety and Health (OSH) in Colombia. Today more than ever, companies recognize that innovation and caring for their human capital are determining factors in achieving excellence and sustainability. This paradigm shift promotes the creation of work environments where inclusion, productivity and resilience become priorities, allowing OSH to transcend its traditional function and consolidate itself as an essential pillar for organizational development. In this way, business advancement is aligned with the responsibility of protecting and valuing those who make the country's growth and competitiveness possible.

Background

Occupational Safety and Health (OSH) in Colombia has its roots in the early 20th century, when concern for the protection of workers began to be reflected in national legislation. A fundamental milestone was Law 57 of 1915, known as the “Uribe law”, which addressed work-related accidents and occupational diseases for the first time, laying the foundations for the definition of work-related accidents and establishing economic benefits and responsibilities for employers.

During the following decades, laws and decrees were enacted that strengthened worker protection, such as Law 46 of 1918 on hygiene and health, Law 37 of 1921, which created collective life insurance, and Law 10 of 1934, which regulated occupational diseases and other labor rights.

In 1945, Law 6 (General Labor Law) consolidated provisions on professional associations and labor conventions, while the creation of the Social Security Institute in 1946 marked a crucial advance in health and pension coverage for Colombian workers.

Consolidation and modernization

The development of OSH continued with the promulgation of Law 9 of 1979, which established basic safety standards at work and reinforced the responsibility of employers in creating safe work environments. Subsequently, the Occupational Risk System (SRL), created in 1993 by Law 100, integrated the prevention, care and compensation of accidents and occupational diseases, and gave way to the appearance of the Occupational Risk Administrators (ARL).



Innovation and digitalization today

In recent decades, OSH in Colombia has experienced a transformation driven by digitalization, technological innovation and a more comprehensive vision of workplace well-being. The adoption of virtual platforms for training, real-time risk monitoring and predictive incident analysis have begun to redefine OSH management in the country. This process has been accelerated by the COVID-19 pandemic, which promoted the implementation of new practices such as teleworking and priority attention to mental health.

Challenges and opportunities

Despite regulatory and technological advances, challenges persist such as the reduction of labor informality, the standardization of OSH training and the adaptation of regulations to international standards. The future of OSH in Colombia will depend on the ability to integrate innovation, digitalization and a focus on comprehensive well-being to build safer, healthier and more inclusive work environments.

In addition to the general regulatory and evolutionary background already known, the following relevant milestones and processes are highlighted to understand the current and future context of OSH in Colombia:

First early laws and regulations (20th century)

Since 1904, with the intervention of Rafael Uribe Uribe, formal concern for occupational safety began, which crystallized in Law 57 of 1915, the first regulation on occupational accidents and occupational diseases in Colombia. Subsequently, laws such as 46 of 1918 (hygiene and health), 37 of 1921 (group life insurance), and 10 of 1934 (regulation of occupational diseases and labor rights) laid the foundations for worker protection.

Institutional consolidation and regulations in the middle of the 20th century:

In 1945, Law 6 (General Labor Law) established provisions on labor conventions and professional associations. In 1946, the Social Security Institute (ISS) was created, which assumed the provision of health and pension services for workers, and in 1948 specific industrial safety and occupational hygiene policies were established.

Regulatory development in the last decades of the 20th century



Law 9 of 1979 reinforced basic safety and health standards at work, assigning clear responsibilities to employers and workers. The creation of the Occupational Risk System (SRL) in 1993 through Law 100 was a fundamental advance for the prevention, attention and compensation of occupational risks. In parallel, joint occupational health committees and health programs were established in companies to promote active prevention.

Evolution towards a comprehensive and modern system (21st century)

Law 1562 of 2012 modified the Occupational Risk System and established the Occupational Health and Safety Management System (SG-SST), promoting a more comprehensive and preventive approach. The implementation of the SG-SST has required subsequent regulatory adjustments (Decreets 171 of 2016 and 52 of 2017) to facilitate its adoption in organizations. This system seeks to improve the work environment, quality of life and reduce accidents and occupational diseases.

Innovation and digitalization as new frontiers

In the last decade, OSH in Colombia has begun to incorporate digital tools for virtual training, real-time monitoring and predictive risk analysis, promoting more efficient and proactive management. The COVID-19 pandemic accelerated the adoption of these technologies and highlighted the importance of comprehensive well-being, including mental health and teleworking, as essential components for the future of OSH.

These antecedents reflect a trajectory of regulatory, institutional and cultural consolidation that supports the current project, aimed at integrating innovation, digitalization and comprehensive well-being to build safer, healthier and more inclusive work environments in Colombia.

METHODOLOGY

The project will adopt a qualitative and descriptive approach, supported by documentary analysis, expert interviews and case studies, to understand the evolution, challenges and opportunities of occupational health and safety (OSH) in Colombia under the prism of innovation, digitalization and comprehensive well-being.

Document analysis

Review and analysis of current regulations, public policies, technical reports, academic literature and institutional documents related to OSH in Colombia. This stage allows us to contextualize the advances, identify trends and establish the reference framework of the study.

Interviews with experts

Conducting semi-structured interviews with OSH specialists, representatives of government entities, business leaders, occupational risk professionals and academics. The objective is to collect perceptions, experiences and recommendations on the processes of innovation, digitalization and promotion of well-being in the Colombian workplace.

Case study

Selection and analysis of representative cases of organizations that have implemented innovative or digital OSH practices, or that have developed comprehensive workplace well-being strategies.

The case study illustrates good practices, identifies success factors and lessons learned, as well as the challenges faced in the adoption of new technologies and approaches.

Qualitative analysis and interpretation

The information collected will be analyzed using coding and categorization techniques, looking for patterns, trends and relationships between the different elements investigated. Understanding the discourses, perceptions and experiences of the actors involved is prioritized, in line with the qualitative approaches recommended for SST research.

This methodology will allow us to obtain a comprehensive and in-depth vision of the current state and perspectives of safety and health at work in Colombia, under the prism of innovation, digitalization and comprehensive well-being.

RESULTS AND DISCUSSIONS

The research results reflect a panorama with significant advances and persistent challenges in OSH management in the country, with emphasis on the incorporation of innovation and digitalization to improve labor well-being.

On the other hand, More than 50% of the employed population in Colombia works in informal conditions, which limits their access to social security benefits and increases their exposure to

occupational risks. It is worth highlighting that workers face hygienic, ergonomic and psychosocial risks, with a high prevalence of prolonged postures, repetitive movements and long hours, which affect physical and mental health. Although the incidence of occupational accidents has decreased since 2014, the mortality rate from these accidents has increased, especially in sectors of high risk such as mining, construction and manufacturing industries, which underlines the need to strengthen prevention.

The implementation of the Occupational Risk System (Law 100 of 1993) and the Occupational Health and Safety Management System (SG-SST) (Law 1562 of 2012) have been important milestones. However, fundamental ILO conventions (155 and 187) have not yet been ratified, which represents an opportunity to align national regulation with international standards. The number of graduates in technical and university programs in SST has increased significantly, but it is necessary to standardize skills and academic quality, especially in virtual and distance modalities. The adoption of virtual platforms for training, real-time monitoring and predictive incident analysis has begun to transform OSH management, facilitating prevention and early intervention. The COVID-19 pandemic accelerated the incorporation of practices such as teleworking and mental health care, evidencing the importance of a holistic approach that integrates comprehensive well-being, inclusion and equity in work environments.

MSMEs represent 94.9% of the Colombian business fabric and require support to implement effective OSH systems, given their limited technical capacity and resources. It is recommended to increase labor inspection personnel to get closer to the international standard (one inspector for every 10,000 workers) and improve supervision and compliance with standards.

The future of OSH in Colombia depends on the ability to integrate technological innovation, digitalization and an approach focused on the comprehensive well-being of workers. This involves overcoming informality, strengthening training, improving regulation and promoting an organizational culture that prioritizes physical and mental health, inclusion and sustainable productivity.

OSH is evolving towards more proactive and technological models. The adoption of digital tools, specialized software and real-time monitoring platforms for the preventive management of

occupational risks stands out. Digitalization makes it possible to anticipate incidents and improve efficiency in decision-making.

Artificial intelligence and big data analytics are being deployed to predict and prevent accidents, measure conditions such as fatigue, and analyze hazardous atmospheres. This facilitates early and personalized interventions in the workplace

The focus on worker well-being has expanded, prioritizing mental health, personalized ergonomics, and reducing stress and anxiety. Conversation spaces, coaching sessions and applications for emotional support are promoted, in addition to adaptive workstations and smart chairs.

Traditional trainings are being replaced by dynamic methodologies, such as simulations with virtual reality (VR), augmented reality (AR), gamification and microlearning. These tools improve knowledge retention and allow immersive training in real risk scenarios.

Decision-making in OSH is increasingly supported by data collected by software and smart devices, allowing for more effective preventive actions. Additionally, there is a growing commitment to sustainability, using eco-friendly personal protective equipment and environmentally responsible business practices.

A high level of labor informality persists (over 50%), which limits access to social protection and increases exposure to risks. It is recommended to strengthen labor inspection and support micro, small and medium-sized enterprises (MSMEs) to implement effective OSH management systems.

Colombia has made progress with laws such as 100 of 1993 and 1562 of 2012, but still faces the challenge of ratifying key international conventions (ILO 155 and 187) and standardizing the training of human talent in OSH, especially in virtual modalities.

The future of OSH in Colombia will be marked by the integration of digital technologies, artificial intelligence, comprehensive well-being and sustainability. Companies will have to adapt to these changes through continuous training, innovation in preventive management and a person-centered approach, to build safer, healthier and more productive work environments.

There is no specific data that shows exact percentages of each trend on the future of Occupational Safety and Health (OSH) in Colombia, but there are visual summaries and descriptions of the key trends for 2025.



Table 1

Trend	Summary Description
Digitization and preventive management	Adoption of digital platforms, real-time monitoring and automated document management.
Artificial intelligence and data analysis	Use of AI and big data to predict and prevent accidents, optimize processes and personalize interventions.
Comprehensive well-being and mental health	Focus on mental health, personalized ergonomics and emotional support through apps and coaching.
Innovative training	Implementation of gamification and microlearning for more effective and dynamic training.
Data-driven security and sustainability	Preventive decisions supported by data and commitment to sustainable and ecological practices.
Structural challenges	High labor informality (more than 50%), need to strengthen inspection and support for MSMEs.
Regulations and international standards	Regulatory progress, but ratification of ILO conventions 155 and 187 and standardization of training is missing.

Source: Pabon, H. (2025)

The central discussion of the article revolves around how the digital revolution is transforming occupational health and safety (OSH) management in Colombia. The integration of technologies such as artificial intelligence (AI), sensors, wearable devices, virtual and augmented reality makes it possible to identify risks, predict accidents and occupational diseases, and monitor in real time both the health of workers and the environmental conditions in the workplace.

These innovations not only make more proactive and personalized risk management possible, but also open the door to solutions tailored to each company, depending on its needs and resources. For example, AI can analyze large volumes of historical data to identify risk patterns, while virtual reality is used to train workers in controlled environments, especially in high-risk activities such as working at heights or confined spaces.

The article highlights the importance of Resolution 312 of 2019, which establishes the minimum standards for the Occupational Health and Safety Management System (SG-SST) and allows the use of digital tools for document management, accident notification and virtual training. The Occupational Risk Administrators (ARL) have been key in the development and implementation of these technologies, supporting companies in the adoption of monitoring and data analysis systems for accident prevention.



Beyond regulatory compliance, the trend is toward a comprehensive approach to well-being, which includes the physical, mental and social health of workers. The article points out that the digitalization of SST offers unprecedented opportunities to improve working conditions, but also presents challenges related to the security of workers' personal and health information, complying with privacy regulations, not all companies, especially small and medium-sized ones, have the same capacity to implement advanced digital solutions, on the other hand a high percentage of workers in Colombia remains outside the formal system, which makes effective coverage and protection in SST difficult and stress and psychosocial risks emerge as growing challenges in the work environment. modern.

CONCLUSIONS

Occupational health and safety (OSH) in Colombia is undergoing a profound transformation driven by digitalization, artificial intelligence (AI) and the adoption of new technologies. These innovations allow for more efficient and proactive management of occupational risks, facilitating the early identification of dangers and the prevention of accidents and occupational diseases.

The integration of AI and digital tools allows analyzing large volumes of data to identify patterns and trends, anticipating risks and optimizing preventive decision making, the use of sensors, portable devices and real-time monitoring systems contributes to improving working conditions, especially in high-risk sectors, by detecting and mitigating dangers before incidents occur, virtual and augmented reality are being used to train workers in controlled environments, improving training in high-risk tasks such as work at height or in confined spaces. Digitalization facilitates document management, incident notification and access to virtual training, streamlining regulatory compliance and self-assessment of OSH management systems.

The future of OSH in Colombia not only focuses on accident prevention, but on a comprehensive approach to well-being that includes mental health and work-life balance, especially relevant in the context of teleworking. Innovative projects, such as web information systems for monitoring and promoting healthy practices in teleworking, seek to address the challenges of mental health and work-related stress, providing mindfulness tools and metrics for continuous improvement. Challenges persist in technological appropriation, worker training, and regulatory updating to ensure compliance. data protection and cybersecurity in the handling of sensitive information.



Close collaboration between the government, companies and Occupational Risk Administrators (ARL) is essential to overcome barriers and ensure that the benefits of digitalization reach the largest number of workers and companies possible. Digitalization, innovation and the focus on comprehensive well-being are redefining the future of safety and health at work in Colombia. Companies that adopt these trends will not only comply with regulations, but will improve their productivity and consolidate their leadership, building safer, healthier and more resilient work environments for all.

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